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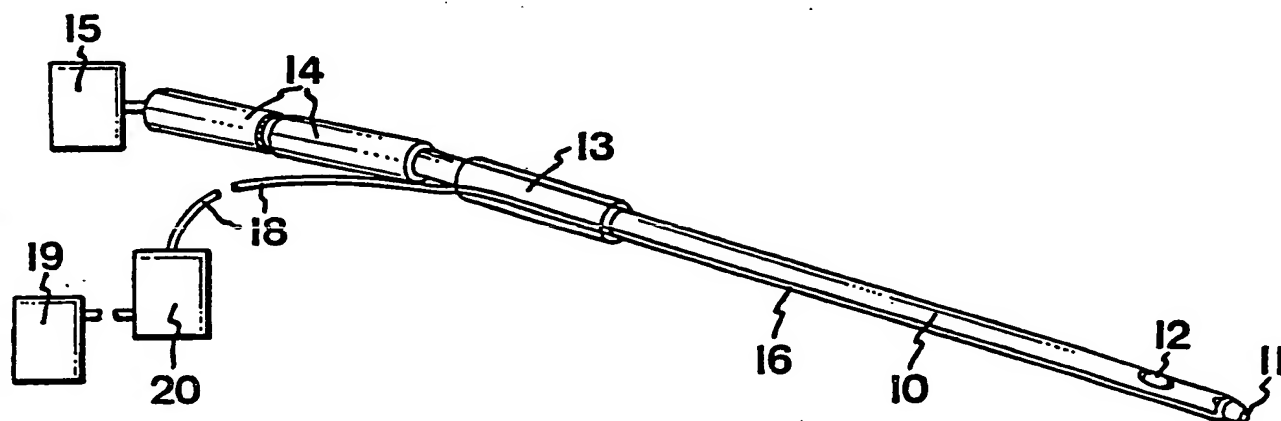
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(54) Title: SURGICAL INSTRUMENT



(57) Abstract

The invention relates to an instrument, especially but not exclusively for removing tissue, comprising an elongate, tubular member (10) whose one end is directly or indirectly connected to a suction pump (15) for generating a subpressure in the tubular member (10), the tubular member (10) being provided with at least one inlet (12) through which the tissue is sucked in under the action of the subpressure in the tubular member (10) so as to be conveyed to a collecting vessel. The instrument is provided with means (19, 20, 16, 17) for supplying the interior of the tubular member (10) with a pressurised liquid which is caused to pass the area of the inlet (12), while simultaneously disintegrating the sucked-in tissue, and subsequently to convey the disintegrated tissue to the collecting vessel.

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SURGICAL INSTRUMENT

The present invention relates to an instrument, especially but not exclusively for removing tissue, comprising an elongate tubular member whose one end is directly or indirectly connected to a suction pump for generating a subpressure in the tubular member, said tubular member being provided with at least one inlet through which the tissue is sucked in under the action of the subpressure in the tubular member so as to be conveyed to a collecting vessel.

A tubular instrument connected to a suction pump is known in plastic surgery and is generally used to suck out fatty deposits. One advantage of this instrument is that long and disfiguring scar formations can be avoided although the operation area may be large. The tubular member which typically is of a length of 150-200 mm and a diameter of 3-10 mm, is inserted through centimetre long incisions in the skin and is hermetically connected to a suction pump with a collecting vessel. The inlet through which the fatty tissue is sucked in is either blunt or cutting. By moving the instrument back and forth under the skin, the tissue introduced into the inlet is torn or cut loose in lumps which are several millimetres in diameter, and is sucked out into the collecting vessel. Large blood vessels slide away from the inlet and therefore are preserved at least to some extent.

This technique suffers from several drawbacks. No accuracy is possible since the removal of tissue occurs unevenly, and sometimes no tissue at all is removed. This is due to the fact that the subpressure in the inlet of the tubular member, through which the tissue is to be sucked in, ceases when tissue that has already been torn or cut loose, clogs the tube. The operation area must therefore be sucked several times, which significantly prolongs the operation time and causes increasing irritation of the tissue. There will also be bleeding of

clinical consequence, especially when the edges of the inlet of the tubular member are designed to be cutting. In a large number of patients, cosmetically unsatisfactory dimples in the skin remain in the operation area, which at least in part can be explained by the unsatisfactory function. The field of application for the prior art instrument is besides restricted to fatty tissue.

One object of the invention is to provide an instrument of the type mentioned by way of introduction, by means of which the above drawbacks in removing tissue are eliminated.

A further object is to provide an instrument which is more versatile and can be used to remove e.g. tumour tissue.

A still further object of the instrument according to the invention is to facilitate removal of such tissues from the inside of the artery walls as can cause constriction of the artery and result in impaired or, sometimes, stopped blood supply to the tissue.

The characterising clause of claim 1 states the distinctive features of the invention.

Since the pressurised liquid supplied to the tubular member is caused to pass the area of the inlet of the tubular member, the tissue which, as the instrument is moved, is gradually introduced into the inlet of the tubular member, will be exposed to this pressurised liquid and broken up into extremely small tissue fragments, typically including about 4-300 cells (this applies to fatty tissue). The pressurised jet of liquid passes the inlet substantially in parallel with the plane of the inlet and "cuts" the tissue to pieces as it is sucked into the inlet. At the same time this fragmented tissue is subjected to the sucking action of the suction pump, and the mixture of liquid and fragments is sucked into the collecting vessel. The pressurised liquid hits the tissue in the form of a jet whose diameter, distribution and direction are determined by the shape and orientation of the nozzle. The

jet loses a minor portion of its kinetic energy when it hits the tissue, and assists most effectively in conveying the liquid and the fragmented tissue in the direction of the sucking action. The subpressure in the tubular member prevents liquid from passing into the surrounding tissue. The advantage of the instrument resides in even and, consequently, rapid removal of tissue. The draining function is secured in that the tissue fragments are so small that the tubular member cannot be clogged, at the same time as the conveyance to the collecting vessel is rendered more effective by the thrust of the jet of water. The power of the jet can be adjusted so that tissue of different density can be excised, and optimised to save blood vessels. The size of the inlet can also be varied.

Preferred embodiments of the inventive instrument and distinctive features thereof are stated in the subclaims.

The invention will now be described in more detail below in the form of a number of embodiments and with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of a first embodiment of the instrument according to the invention;

Fig. 2 is a longitudinal section of the excising portion of the tubular member included in the instrument and shown in Fig. 1;

Fig. 3 is a longitudinal section of the excising portion in a second embodiment; and

Figs 4, 5 and 6 illustrate a third, a fourth and a fifth embodiment of the instrument according to the invention.

Figs 1 and 2 illustrate a tube 10 of circular cross-section which can be rigid and made of, for example, a tissue-compatible metal. The tube 10 can also be flexible and then be made of a tissue-compatible plastic material. If the instrument according to the invention is to be used to remove e.g. abdominal fat, its length can typically be 150-200 mm and its inner diameter 4-8 mm. Smaller sizes can be convenient in face surgery and bigger ones in ex-

tensive operations.

In this embodiment, one end of the tube 10 is closed and softly rounded, as indicated at 11. In the vicinity of the closed end there is an oval inlet 12 preferably having non-cutting edges. Normally the inlet 12 is positioned about 5-30 mm from the rounded end 11.

The other end of the tube 10 is designed as or provided with a sleeve-shaped grip or guide portion 13 which is, in turn, connected via a conduit 14 to a suction pump 15, whereby a suction effect in the direction of the arrow B arises.

One wall of the tube 10 is designed as or provided with a duct 16 (Fig. 2) having a diameter of e.g. 2 mm. One end of the duct 16 opens into a nozzle 17 disposed inside or outside the tube 10, between the inlet 12 thereof and the rounded end 11. The aperture of the nozzle 17 is disposed centrally in the tube 10 and directed to the opposite end of the tube 10, as shown by the arrow B which also symbolises the sucking direction provided by the suction pump 15.

The other end of the duct 16 is connected to a thick-walled conduit 18 which is, in turn, connected to a liquid container 19. The liquid in the container 19 is adapted to be pressurised by means of a pressure-generating unit 20 of some prior art type. The liquid in the container 19 is a tissue-compatible solution to which an antibiotic and/or a vasoconstrictive substance is optionally added.

On application of the inventive instrument to tissue, the liquid from the container 19 is caused to flow under a pressure of typically 100-400 bars through the duct 16 in the direction of the arrow A, which results in the nozzle 17 forming a jet 21 whose direction of motion substantially conforms with the sucking direction (arrow B). When the instrument, i.e. the tube 10, is inserted in the tissue or held against a tissue surface, the inlet 12 is clogged, whereby a subpressure is generated inside the tube 10. The tissue (not shown) thus is sucked through the

inlet 12. Under the action of the jet of liquid 21, the sucked-in tissue is broken up into small fragments, and this mixture of liquid and small fragments is fed in the direction of the arrow B at a rate of about 0.5-1 m/s. New
5 tissue is gradually sucked in through the inlet 12 of the tube 10, and by means of the jet of liquid 21 the tissue is excised evenly and rapidly. Owing to the fragmentation of the tissue, the risk that the interior of the tube 10 is clogged, is eliminated. The removed tissue is collected
10 in a vessel (not shown).

Figs 3-6 to which reference is now made, illustrate other feasible embodiments of the instrument according to the invention. The same reference numerals as in Figs 1-2 are used.

15 In Fig. 3, the duct 16 for the pressurised liquid opens into a nozzle 17 which is disposed eccentrically inside the tube 10 and positioned between the laterally arranged inlet 12 and the closed end of the tube 10 and closest to the tube wall which has the inlet 12. Such po-
20 sitioning of the nozzle 17 implies that the jet of liquid 21 attacks sucked-in tissue at a somewhat earlier stage as compared with the embodiment according to Figs 1 and 2.

In Fig. 4, the inlet 12 of the tube 10 is formed in the end thereof. The nozzle 17 is disposed eccentrically
25 inside the tube 10, and the aperture of the nozzle is angularly set so that the pressurised jet of liquid is directed transversely of the longitudinal direction of the tube 10. Thus, the mixture of liquid and fragmented tissue is fed towards the opposite tube wall where the mixture is
30 subjected to the sucking action indicated by the arrow B.

Fig. 5 illustrate that the duct 16 for the pressurised liquid is arranged in one wall of the tube, but it is obvious that the duct 16 can also be arranged inside or outside the cavity of the tubular member, and in the
35 latter case the duct is caused to communicate via a lead-in with the interior of the tube 10 (Fig. 5). The tube 10 through which the tissue fragments are conveyed, can also

be a direct extension of the tube 16 supplying the pressurised liquid (Fig. 6). In this embodiment, the tube 10 usually is flexible. In a tubular instrument according to this embodiment, one end is consequently connected to a liquid reservoir, alternatively having a source of pressure, and the opposite end is connected to a suction pump. The preferably rigid, tubular portion 16 for the pressurised liquid passes after the inlet 12 into a portion which usually, but not necessarily, is flexible and whose interior is subjected to the sucking action (indicated by the arrow B) of the suction pump which is not shown in this Figure.

The instrument according to the invention can also be used outside plastic surgery. Thus, the instrument can also be used to remove vasoconstrictions and tumours.

In each of the embodiments stated above, the tubular member 12 can be provided with prior art fibre optics and, alternatively, electronic sensing means, for locating and monitoring the result of the excusive operation.

Moreover it will be appreciated that the inlet 12 of the tubular member can be provided with a coarse- or fine-meshed grating for preventing big blood vessels from being pulled into the tube 10. The inlet 12 can also be provided with a loop or like member which has non-cutting edges and extends a short distance beyond the circumference of the inlet, thereby facilitating the introduction of tissue.

It is also possible to arrange a nozzle 17 the direction of which can be adjusted within limits by the operator.

To a person skilled in the art it is further obvious that the tube 16 for the pressurised liquid can also be flexible, which is illustrated by e.g. the embodiment shown in Fig. 5.

CLAIMS

5 1. An instrument, especially but not exclusively for removing tissue, comprising an elongate tubular member (10) whose one end is directly or indirectly connected to a suction pump (15) for generating a subpressure in said tubular member (10), said tubular member being provided
10 with at least one inlet (12) through which the tissue is sucked in under the action of the subpressure in said tubular member (10) so as to be conveyed to a collecting vessel, c h a r a c t e r i s e d in that means (19, 20, 16, 17) are adapted to supply the interior of said tubular
15 member (10) with a pressurised liquid which is caused to pass the area of said inlet (12), while simultaneously disintegrating the sucked-in tissue, and subsequently to convey the disintegrated tissue to said collecting vessel.

20 2. The instrument as claimed in claim 1, c h a r - a c t e r i s e d by a tube (16) adapted to conduct the pressurised liquid to a nozzle (17) which in said tubular member (10) produces a jet of liquid which is substantially parallel to the plane of said inlet (12).

25 3. The instrument as claimed in claim 2, c h a r - a c t e r i s e d in that the aperture of the nozzle (17) is disposed centrally in the tubular member (10).

 4. The instrument as claimed in claim 2, c h a r - a c t e r i s e d in that the aperture of the nozzle (17) is disposed eccentrically in the tubular member (10).

30 5. The instrument as claimed in any one of the preceding claims, c h a r a c t e r i s e d in that the nozzle (17) is adapted to conduct the jet of liquid past the inlet (12) in the direction of the end of the tubular member (10), which is connected to the suction pump (15).

35 6. The instrument as claimed in any one of claims 1, 2, 3, or 5, c h a r a c t e r i s e d in that said tubular member (10), upstream of said inlet (12), forms a

duct for the pressurised liquid and preferably is rigid, and that, downstream of said inlet (12), said tubular member (10) is flexible.

7. The instrument as claimed in any one of claims 1-4, characterised in that said nozzle (17) is adapted to conduct the jet of water past the inlet (12) in the direction away from the end of said tubular member (10), which is connected to said suction pump (15) and, after a bend, towards said end.

10 8. The instrument as claimed in any one of the preceding claims, characterised in that the tube (16) through which the pressurised liquid is conveyed forms part of the wall of said tubular member (10).

15 9. The instrument as claimed in any one of the preceding claims, characterised in that the tube (16) through which said pressurised liquid is conveyed is disposed outside said tubular member (10).

20 10. The instrument as claimed in any one of claims 1-8, characterised in that the tube (16) through which the pressurised liquid is conveyed is disposed inside the cavity of the said tubular member (10).

11. The instrument as claimed in any one of the preceding claims, characterised in that said tubular member (10) is rigid.

25 12. The instrument as claimed in any one of claims 1-10, characterised in that said tubular member (10) is flexible.

30 13. The instrument as claimed in any one of claims 1-10, characterised in that the tube (16) through which the pressurised liquid is conveyed is rigid.

14. The instrument as claimed in any one of claims 1-10, characterised in that the tube (16) through which the pressurised liquid is conveyed is flexible.

35 15. The instrument as claimed in any one of the preceding claims, characterised in that said nozzle (17) for the pressurised liquid is adjustable in

any desired angular positions.

16. The instrument as claimed in any one of the preceding claims, characterised in that the tubular member (10) has optical means, preferably fibre optics, for monitoring the removal of tissue.

17. The instrument as claimed in any one of the preceding claims, characterised in that the inlet (12) of the tubular member (10) is provided with a grating.

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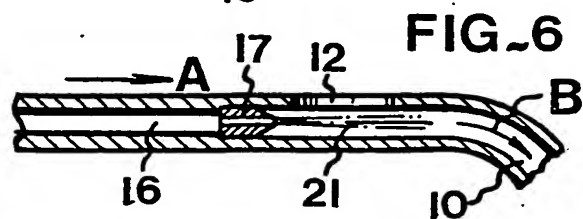
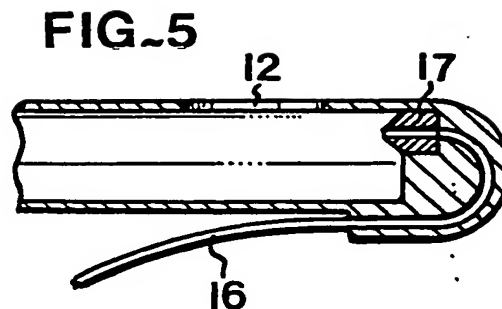
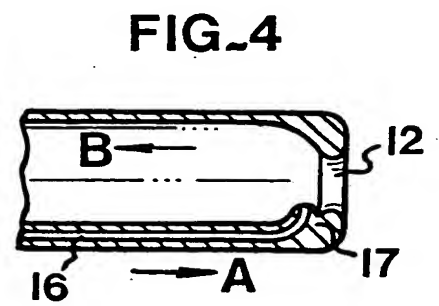
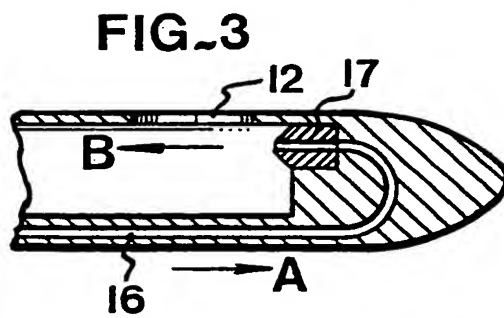
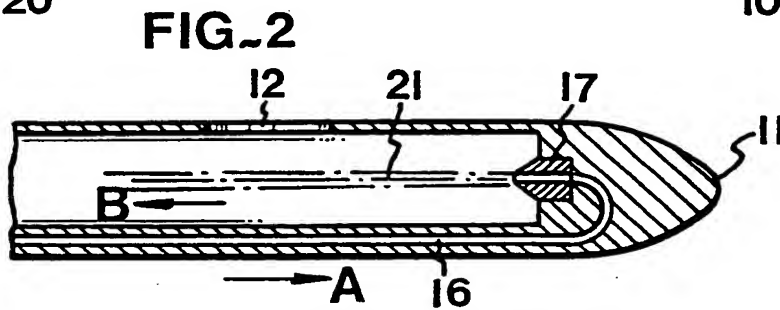
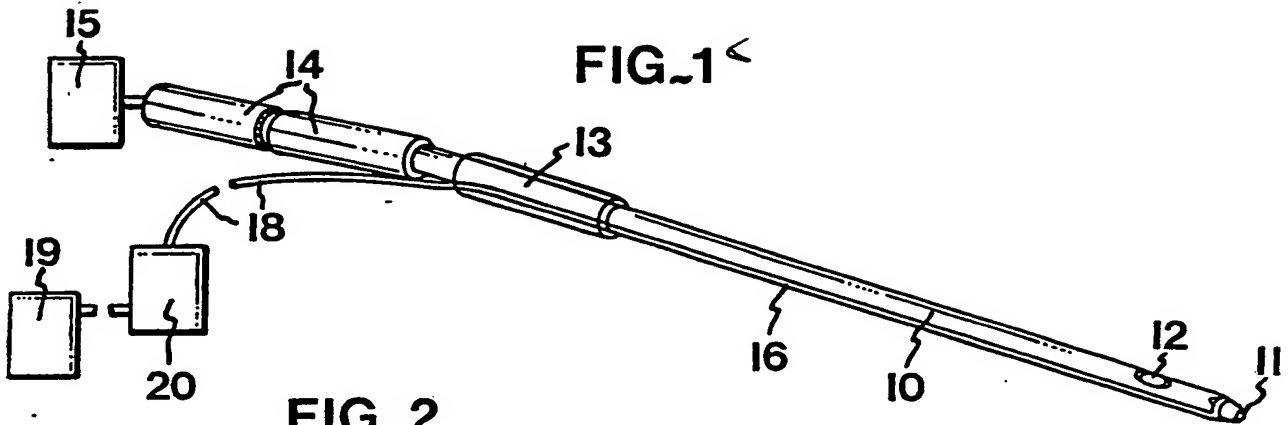
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INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 89/00656

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: A 61 B 17/22, A 61 M 1/00		
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black;">Minimum Documentation Searched ⁷</div> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%; border-bottom: 1px solid black;">Classification System</div> <div style="width: 55%; border-bottom: 1px solid black;">Classification Symbols</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;">IPC5</div> <div style="width: 55%;">A 61 B; A 61 M</div> </div> <div style="text-align: center; margin-top: 10px; font-size: small;"> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸ </div>		
SE,DK,FI,NO classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	EP, A1, 0175096 (VELTRUP) 26 March 1986, see page 7, line 6 - line 8; abstract; figures 1-3 <div style="text-align: center;">--</div>	1,5- 17
A	US, A, 3542031 (TAYLOR) 24 November 1970, see abstract; figures 3-4 <div style="text-align: center;">--</div>	1-17
A	FR, A1, 2568777 (GODDIO) 14 February 1986, see the whole document <div style="text-align: center;">--</div> <div style="text-align: center;">-----</div>	
<div style="display: flex; justify-content: space-between; font-size: x-small;"> <div style="width: 45%;"> <p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 55%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p> </div> </div>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search 4th January 1990		Date of Mailing of this International Search Report 1990 -01- 26
International Searching Authority <div style="text-align: center; margin-top: 10px;">SWEDISH PATENT OFFICE</div>		Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> Hans Peterson </div>

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 89/00656**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A1- 0175096	26/03/86	JP-A- 61068035 US-A- 4690672 DE-A- 3566612	08/04/86 01/09/87 12/01/89
US-A- 3542031	24/11/70	NONE	
FR-A1- 2568777	14/02/86	NONE	